



Ground Mobility Robotics Systems Integration Skunk Works

Inspiring Joint Robotic Programs

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TARDEC

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SUPERIOR TECHNOLOGY FOR A SUPERIOR ARMY

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Robotics Skunk Works

Briefing Outline

- What's TARDEC Skunk Works?
- Historical Foundation – TATRC SBIR contract & collaboration
- Skunk Works work directive contract & collaborative opportunities
- 1st WD – ARDEC / TARDEC TAGS weapons integration
- FIRRE Spiral Technologies
- 2nd WD – NCDR / TARDEC TAGS mechanical arm integration
- MANSCEN / TARDEC chem / engineer robotics
- Summary of Collaborative Opportunities

Robotics Skunk Works



Problem: No formal process to evaluate ILIR & SBIR component technologies at system level prior to transitioning to ATO & PM programs

Schedule

	FY 2006				FY 2007				FY 2008			
Event	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
API Work Directive Contract												
WD-1 TAGS Weapon Robot												
Ft. Knox VTI Joint Operations			^									

Objective: Establish In-house quick reaction, ground mobility, robotics systems integration capability

Approach:

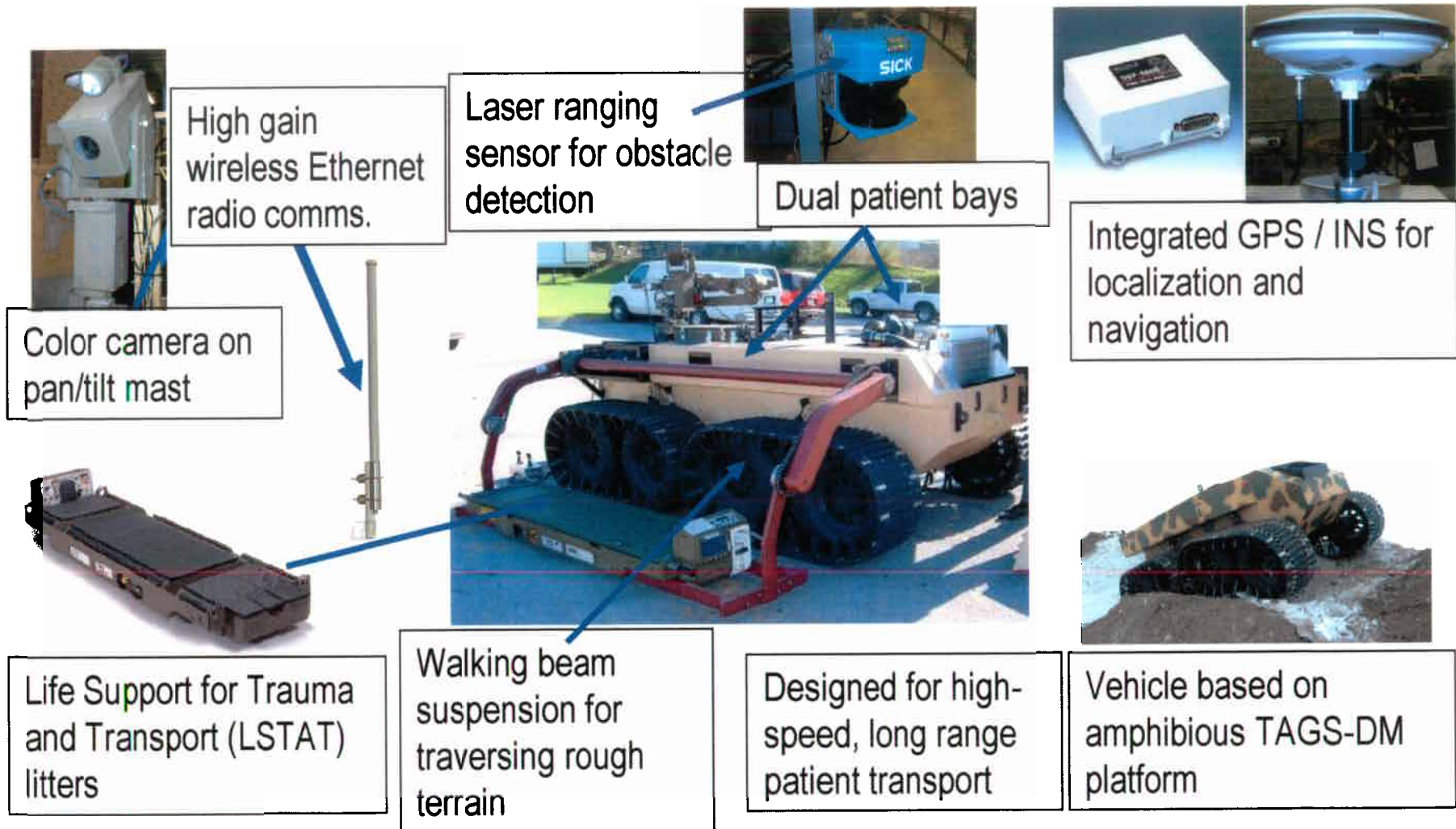
- Create a fleet of heterogeneous **lab robots**
 - JAUS compliant common controls,
 - Standard navigational sensors
 - **plug & play payload hardware & software interfaces.**
- Integrate, demonstrate and evaluate ground mobility robotic technologies.

Benefits:

- **Increase Collaborations**
 - ILIR/SBIR Tech Transition Teams
 - Externally with ARDEC, SPAWAR, JPO, OUSD, Academia (Vetronics Inst.)
- **Showcase Capabilities/Accomplishments**
 - Field Experiments / User Interface
 - Conference Displays / Demonstrations
- **Define Program Requirements**
- **Improve Tech Transition to ATO & PM**

Robotic Evacuation Vehicle (REV)

Applied Perception, Inc. SBIR Contract



Robotic Extraction Vehicle (REX)

Applied Perception, Inc. SBIR Contract



Color, thermal, RF, and UWB
Radar sensors for patient
detection



REX is transported in a
marsupial fashion to the
field by the REV



Manipulator for
patient grasping
and loading.



NATO stretcher for
patient transport

Designed for short
range patient
extraction



Integrated GPS / INS for
localization and
navigation



Vehicle based on
ANDROS Wolverine
platform

Robotics Skunk Works

Applied Perception, Inc. SBIR Contract

- Sole Source, 3 yr, Work Directive (WD) contract:
 - Acquire COTS or use GFE mobility platform
 - Modify platform to meet specified mission
 - Integrate JAUS compliant:
 - Standard auto-navigation sensors
 - Mission specific sensors & payloads
 - **Common controls and plug & play interfaces**
- First WD: Joint TARDEC/ARDEC program
 - TAGS-DM mobility platform
 - Non-lethal & lethal weapons integration



Robotics Skunk Works

TAGS Weapons Integration



Work Directive 1 – Contract Awarded

- ❖ Joint Funding-TARDEC & ARDEC
- ❖ Lethal & Non-Lethal Weapon
- ❖ API Systems Integrator
- ❖ Dumur Industries Support
- ❖ Leverage Remotec IRAD

Weight (lbs)	3050
Size (inches)	118Lx75Wx45H
Engine (Hp)	100 HP Turbo charged diesel
Max Payload (lbs)	2400
Speed (Kph)	Up to 48 Kph



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TAGS Weapons Integration



Picatinny Lightweight Remote Weapon Station with M240 (7.62) MG



System Capabilities:

M240/M249 (7.62/5.56mm)

Weight goal: <150 lbs including gun and 200 rounds

Slew rates: 90 deg/sec in Az and El
2-Axis Stabilization, 5Hz, 20 Db goal

Continuous 360 Degree rotation

Elevation Range +45 to -15 degrees

Non-Lethal Integration:

❖ FN-303 Less-Lethal Launcher

❖ Acoustic round detection integrated with PLWRWS

Robotics Skunk Works FN-303 Less-Lethal Launcher



Technology

- Compressed air powered launcher designed to fire **0.58 caliber 8.5 g less-than-lethal projectiles**
- Allows for greater engagement range (100m), higher accuracy, and higher rates of fire than any currently fielded non-lethal capability
- Both stand-alone & under-barrel (M16/M4) versions are available.

Capabilities of Item

- Disperse a crowd between 10-20 meters
- Stop, confuse, disorient an individual from 20-100 meters
- Stop, confuse, disorient a crowd of individuals from 20-80 meters
- Deny an area to personnel
- Stand alone or under-barrel version

Status

- Rapid Equipment Fielding of 30 systems to CTF-180 (Bagram AB, Afghanistan)
- ONS expected for 600 systems for CFLCC – G3 Looking to approve 80
- Add-on Safety Testing Scheduled within next month (bullet impact testing).

Robotics Skunk Works PLWRWS with M240 & FN-303



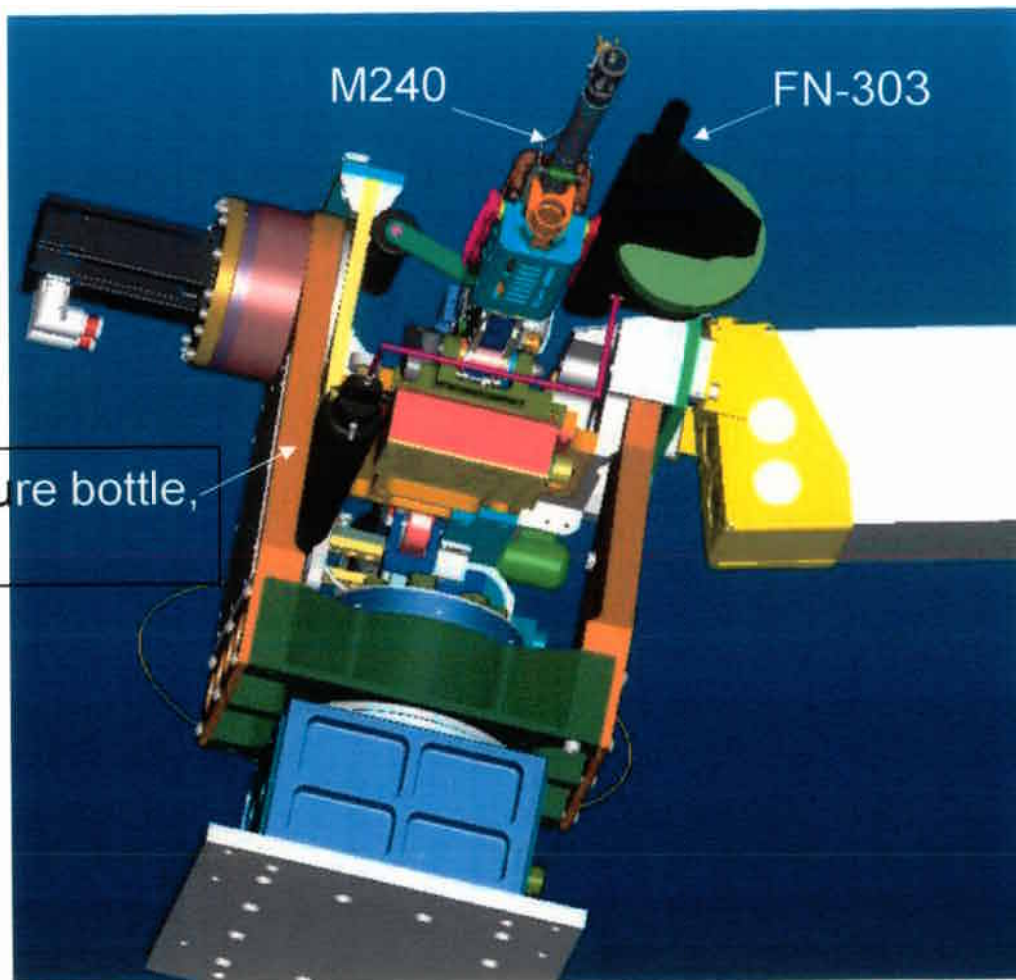
Picatinny CRADA with FN
HERSTAL to modify FN-303
with electric trigger



200 bar pressure bottle,
110 round



.68" projectiles, 8.5g weight,
polystyrene body & granular non-
toxic bismuth forward payload



Robotics Skunk Works

Applied Perception, Inc. SBIR Contract



TAGS-based Weapons Platform
JAUS compliant ARDEC
Weapons Integration

Technology Transition to FIRRE Phase III

- **Std. Sensor Suite:** Scanline and scanning Sick, 6 radars (front, rear, 2 left/right), DGPS/Gyro positioning system, roll and pitch rate gyros, color omnicam, 35 lb capacity pan tilt, 3 color cameras, 1 320x240 FLIR, comms,
- **Operator Control Units (OCU) :** Hand Held PDU & Laptop Computer
- **JAUS Compliant Software**
- **Programmable Mission Scenarios** (e.g., come to me, GPS waypoint, OD/OA,...)

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TAGS-DM modifications

- **Top surface:**
 - **Span full width of vehicle** to outside track edges
 - **Structural I-beam rail mounts** to allow weapons placement and operation in forward, rearward and central vehicle locations
- **Marsupial / Payload bay:**
 - **Electric / hydraulic access panels** (vertical surfaces in bay)
 - Widened to transport tracked wolverine-based robot.
 - Locking mechanisms to secure marsupial robot into the bay.
 - Loading ramp made of perforated/grate type material & flare open at base
 - Manual controls accessed through **password protected touchpad**.
- **Engine and hydrostatic drive systems** - moved forward.
- **Semi-active suspension & two speed Poclain wheel motors**
- **Fuel tank & filler** - sized & positioned for 200 km mission & safe easy access.
- **J AUS compliant GFE weapons integration**

Technology Transition to FIRRE Phase III

Robotics Skunk Works

- Status: Contract award 26 Sept., 2005
- Coordination: TARDEC/ARDEC meeting with MANSCEN to discuss robot & non-lethal/lethal requirements
- Initial WD Program Objectives:
 - (VTI) joint operations technology demonstration in July, 2006
 - Technology transition to ART ATO, FCS ARV & PM-FPS FIRRE
 - Obtain joint funding for Needs-Based Robotic Demonstrators (Expand Skunk Works Capabilities)



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MANSCEN / TARDEC Collaboration



Unmanned Systems Advanced Technology Assessments

- **Provide Prototype Experiment Support to the MANSCEN Futures Center, Military Police, Chemical, and Engineer Schools to Modernize the Current Force and Develop Future Force Requirements.**
- **Provide Prototype Experimentation Support to Joint Robotics Program (JRP) to Develop, Evaluate, and Support Unmanned Systems Throughout the Life Cycle.**



Robotics Skunk Works

Autonomous Robotic Decontamination



Teams of Robots Provide Collaborative Semi Autonomous Tactical Decontamination in Forward Combat Areas.

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NCDR / TARDEC Collaboration

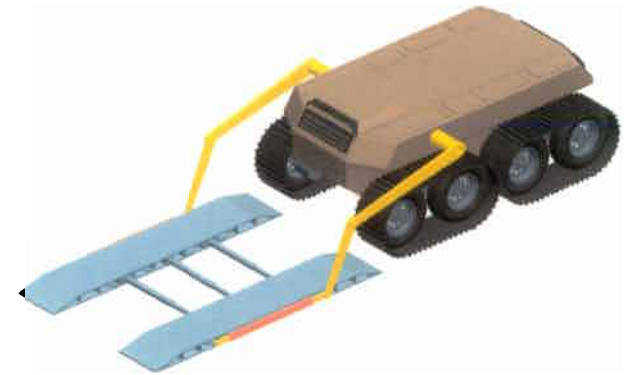
NCDR developed JAUS Compliant Hydraulic Arm to be Integrated with TARDEC TAGS Robotic Vehicle using Plug & Play I-Beam Rail System



Robotics Skunk Works

TAGS Robotic Bridger Demonstrator

- TARDEC Tech Director funds
 - TAGS Robotic base-platform
 - Funds required for
 - Robotic retrofit
 - GFE bridge integration
- Bridging Group in Engineering
 - Two BAA contracts for bridging demonstrators
 - GFE bridge for TAGS integration
- Advanced Concepts – TAGS Integration of either
 - Aluminum/Composite Expansion Bridge
 - Fascine Deployment Bridge



Robotics Skunk Works Funding Issues

- Skunk Works 1st Work Directive
 - Tech Director funds get tele-operated TAGS vehicle
 - OUSD JPO funds semi-autonomy & autonomous capabilities, as well as JAUS compliant weapons payload integration & support
- TAGS Robotic Bridger Demonstrator
 - Tech Director funds TAGS vehicle, with vehicle payload modifications & teleop / waypoint following capabilities
 - Funding required for OD/OA capabilities and Bridge Integration
 - **Interim capability demonstrator:** MANSCEN Anti-mine or Decontamination Robot payload integration support
- Decontamination effort might be co-funded by **National Center for Defense Robotics (NCDR)**



TARDEC Robotics Skunk Works

Inspiring Joint Robotic Programs



Description: TARDEC & ARDEC joint program to integrate lethal and non-lethal weapons onto the Tactical Amphibious Ground Support (TAGS) vehicle. Vehicle mission includes sentry perimeter security operations. Plug & play hardware and software concepts being applied to demonstrate vehicle mission reconfiguration. Alternate mission being considered under joint TARDEC & TATRC program for robotic combat casualty evacuation & extraction (RCCE&E), for which the TAGS would have removable patient bays.

Utility: Provide Customer Robot Mission Application Demonstrators

Sole Source, 3 yr, Work Directive contract to:

- ❖ Acquire COTS or use GFE platform
- ❖ Modify platform to meet specified mission
- ❖ Integrate JAUS compliant:



- Standard auto-navigation sensors
- Mission specific sensors & payloads
- Common controls and plug & play interfaces



- ❖ Integrate marsupial casualty extraction & modular patient bays for evacuation.

Customers: Customers include PM-Force Protection Systems and Maneuver Support Center

Partners: Armaments Research Development and Engineering Center (ARDEC) and Telemedicine and Advanced Technology Research Center (TATRC)



Schedule

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API Work Directive Contract												
WD-1 TAGS Weapon Robot												
Ft. Knox VTI Joint Operations												

Funding:
FY05 = \$850K
FY06 = \$229K

Lethal / Non-Lethal Considered:

- ❖ Picatinny Lightweight Remote Weapon Station with M240/M249
- ❖ FN-303 Less-Lethal Launcher
- ❖ Acoustic round detection integrated with the PLWRWS